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<p align="center">Division of Forensic Science</p> <p align="center">TRACE EVIDENCE PROCEDURES MANUAL</p>	<p align="center">Amendment Designator:</p>
	<p align="center">Effective Date: 31-March-2003</p>
<p align="center">9 GLASS ANALYSIS</p> <p>9.1 Analytical Approach</p> <p>9.1.1 Forensic glass examinations usually involve the comparison of a questioned glass sample with a known sample from a broken glass source. The questioned glass samples may either be fragments submitted directly as an item or particles recovered from clothing or objects. The glass samples are analyzed by determining physical properties and refractive index for the known and questioned glass samples. Particle size sometimes precludes the determination of some or all of a glass particle's physical properties. In this situation, physical properties are determined to the extent possible, and conclusions are drawn based on those properties that can be determined.</p> <p>9.1.2 Glass comparison examinations should be considered for fracture match examination, if feasible. Physical fitting provides the only conclusive association between glass samples.</p> <p>9.1.3 Another examination that may be requested is glass identification. A request may be that a submitted sample be identified as glass, or it may be to identify the type of glass in a sample. Physical properties and/or refractive index measurements are determined to the extent necessary to reach a conclusion.</p> <p>9.1.4 Mineral wools, which are found in insulation material, may be encountered in forensic casework. Questioned mineral wool fibers, which may be recovered from clothing or objects, may be compared to known insulation from the scene. Mineral wools are glass fibers and may be analyzed, in part, like glass particles. Physical properties to be compared include fiber diameter, color of resin coating if present, presence of slugs, UV fluorescence and solubility in hydrochloric acid. Refractive index can be compared, but the samples must first be annealed. The annealing process gives the sample a more uniform refractive index within the sample.</p> <p>9.1.5 Direction-of-impact determination may be requested for a submitted glass sample. In order to make this determination, the broken glass source must be non-tempered. In addition, the correct inside/outside orientation must be provided by the investigator. This should be accomplished by marking the fragments still in the frame with the correct orientation at the time of collection. All of the larger pieces should be submitted, including: those from the floor, those from the ground and those found in the frame. The broken pane is reconstructed and, if possible, the point-of-impact and cracks radiating from that point are identified. Ridges on these radial cracks are examined to determine from which side the glass pane was broken.</p> <p>9.1.6 Glass sources sometimes have other materials such as paint, decals, or tint films associated with them. These materials may be transferred with glass particles and may increase the evidentiary value of the glass. Comparisons of glass samples such as this should also include comparison of these associated materials. These examinations will be performed in accordance with the applicable Trace Section protocols.</p> <p>9.2 Recovery of Glass Particles from Clothing and Objects</p> <p>9.2.1 Purpose</p> <p>This procedure is necessary to isolate glass particles for characterization and subsequent comparison with known glass samples.</p> <p>9.2.2 Minimum Standards and Controls</p> <p>9.2.2.1 All glassware is cleaned prior to use.</p> <p>9.2.2.2 Processing table/area must be cleaned before and after each use.</p> <p>9.2.2.3 Minute glass particles recovered from debris must be clean in order to perform testing procedures.</p> <p>9.2.2.4 Known glass samples are isolated from items being processed to prevent contamination.</p>	

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9.2.3	Analytical Procedures	
9.2.3.1	Prepare an examination sheet and lay out item(s) to be examined on new, clean paper. Shake and/or scrape the inside of the package over the paper.	
9.2.3.2	<p>Describe each item to be processed for glass particles. For clothing items, note general type, color(s), patterns and label information, including size and manufacturer. Note the overall appearance of each item (new, worn, clean, soiled, apparent blood stains, fabric separations, etc.).</p> <p>For objects such as tools or weapons, note type, color, manufacturer, size and appearance as appropriate. Objects may exhibit scratches, gouges or other damage, which should be noted.</p>	
9.2.3.3	<p>Using a spatula, scrape clothing item(s) over paper. Scrape inside pockets and cuffs, if present. Personal items (from pockets) should be listed on the examination sheet and retained with originating item. Clothing items from a single individual, with the exception of shoes, may be processed together to yield combined debris from a set of items. Shoes must be processed separate from other clothing, due to the possibility that extraneous glass from the environment may be present. If right and left shoes from a single individual are submitted as separate items, these may be processed together to yield combined debris from the items. It may be necessary to use a small spatula or probe to remove debris from the soles of shoes.</p> <p>If clothing and shoes are submitted from a particular suspect, the clothing items are considered to be the best evidence for glass examination. If glass particles are recovered from the clothing items and subsequently associated with the known glass source, the shoes may not be necessary for examination. This is determined on a case-by-case basis.</p> <p>Rigid objects such as tools and weapons are processed by the most appropriate means, depending on the item. Brushing an item over paper using new, clean, disposable paint brushes usually yields the best results. If particles are embedded in a soft object such as plastic, wood or aluminum, probing in gouges may be the most effective means of removal.</p>	
9.2.3.4	Collect debris and retain in a labeled container (plastic container, evidence fold, etc.) If apparent glass particles are seen visually they may be retained in a separate container.	
9.2.3.5	Thoroughly examine the recovered debris for glass particles using a stereomicroscope (usually 30X-40X magnification). Describe the overall make-up of the debris. For larger quantities of debris, search a small amount at a time, using a probe. Remove apparent glass particles based on clarity, irregular shape, hardness, freshness of edges, and conchoidal fracture. Place the recovered particles in a labeled depression slide. Recover at least ten (10) particles, if that many can be found. If more exist in the debris, more than one broken glass source was submitted for comparison, and the sources are distinguishable, recover additional particles as needed. The general rule is ten particles per separate known glass sample.	
9.2.3.6	In a dry mount in the depression slide, examine the recovered particles using a polarized light microscope or stereomicroscope with transmitted illumination and a polarizing attachment. Anisotropic particles, those which exhibit birefringence using crossed polars, are eliminated as glass particles. Particles that exhibit no interference colors using crossed polars are isotropic particles. Isotropic particles having the physical properties indicated above are therefore identified as glass. If the recovered particles are isotropic, indicate in the case notes that the particles were examined using crossed polars and were isotropic.	
9.2.3.7	Glass particles are transferred to a small labeled beaker (such as the 50 ml size) and 10-20 ml of 5% micro detergent solution is added. The beaker is placed in an ultrasonic cleaner and set to clean for 10 minutes. The particles are washed into a coned filter paper in a funnel with deionized water and rinsed well. The clean glass particles are recovered from the filter paper for comparison to known samples.	

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<p>9.2.3.7.1 Alternate Cleaning Procedure for Recovered Glass Particles:</p> <p>Glass particles are washed directly in the depression slide in a 5% micro detergent solution in an ultrasonic cleaner. The depression slide is placed in a 100mm diameter Pyrex Petri dish. A small amount of deionized water is placed in the Petri dish and in the bottom of the ultrasonic cleaner which is set to clean for 5 minutes. The particles are then transferred to the second depression well on the slide and rinsed in deionized water by 5 minute sonication. The clean glass particles are recovered from the depression slide for comparison to known samples.</p>		
9.2.4	References	
9.2.4.1	Miller, E.T. "Forensic Glass Comparisons", in <u>Forensic Science Handbook</u> ; R. Saferstein, ed, Prentice Hall:Englewood Cliffs, NJ 1982.	
9.2.4.2	Nelson, D.F. "The Examination of Glass Fragments" in <u>Methods of Forensic Science</u> ; A.S. Curry, ed, Interscience Publishers:London.	
9.2.4.3	Harrison, P.H.; Lambert, J.A.; Zoro, J.A."A Survey of Glass Fragments Recovered from Clothing of Persons Suspected of Involvement in Crime"; <u>Forensic Science International</u> , 1985, 27, pp. 171-187.	
9.2.4.4	Brewster, F.; Thorpe, J.; Gettinby, G.; Caddy, B.; "The Retention of Glass Particles on Woven Fabrics"; <u>Journal of Forensic Sciences</u> , 1985, 30, 3, pp. 798-805.	
9.2.4.5	McQuillan, J.; Edgar, K. "A Survey of the Distribution of Glass on Clothing"; <u>Journal of Forensic Science Society</u> , 1992, 32, 4, pp.333-348.	
9.3	Physical Properties	
9.3.1	Purpose	
	This procedure is used to characterize the physical properties of a glass sample or individual glass fragment for comparison of these properties with other samples or fragments.	
9.3.2	Safety Considerations	
9.3.2.1	When using the UV lamp, safety glasses that provide UV protection should be worn.	
9.3.2.2	Extreme care should be taken to prevent lacerations from glass samples, especially when working with laminated glass samples.	
9.3.2.3	Density comparisons should be conducted in a fume hood or in a vented area.	
9.3.3	Minimum Standards and Controls	
9.3.3.1	Work area must be cleaned before and after each use.	
9.3.4	Analytical Procedures	
9.3.4.1	Glass comparison examinations should be considered for a fracture match examination if adequate known and questioned samples are submitted.	
9.3.4.1.1	Physical fitting provides the only conclusive association between glass samples.	

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9.3.4.2	Prepare a glass worksheet (Appendix 19) and record visual observations. These observations include, but are not limited to, color, type, shape, inclusions, surface texture and surface markings. Examine a sufficient number of fragments in the sample to determine if multiple broken glass sources may be present in the sample.	
9.3.4.2.1	Laminated glass, if submitted in its complete form, should be sampled from both panes and treated as two separate samples.	
9.3.4.3	In a darkened room, examine flat manufactured surfaces using short wavelength UV. If a flat glass sample exhibits a marked fluorescence on one side and not on the other, it is determined to be a float glass. Record whether the sample is a float or a non-float glass. Glass samples may also exhibit an overall fluorescence rather than only on the float surfaces. Examine the sample using both long and short wavelengths. Record fluorescence observations on the worksheet for both long and short wavelengths.	
9.3.4.3.1	If it is readily apparent that a float glass is present in the case samples then proceed with the determination of physical properties. If no readily apparent float glass is present, then check the short wavelength UV lamp with a known float glass to ensure that it is functioning properly. Record this on the glass worksheet.	
9.3.4.4	If two parallel manufactured surfaces are present, measure the thickness of the glass sample using a micrometer and record the value to the one hundredth of a millimeter. Measure a representative number to determine if a thickness range exists.	
9.3.4.5	If the glass sample has a highly reflective but transparent manufactured surface, determine if the glass is from a low emissivity (low-E) source. Press the two probes of a continuity tester against the surface without allowing them to touch each other. If the surface conducts electrical current, the sample is a low-E glass. Low-E glass conducts electrical current on one manufactured surface but not the other.	
9.3.4.6	If the questioned and known glass samples being compared cannot be distinguished by the physical properties discussed above, the refractive indices of the samples are compared (See ¶ 9.4).	
9.3.4.7	If the questioned sample is consistent with the known sample in all other physical properties as well as refractive index, and if particle size permits, density is evaluated by a comparison method.	
9.3.4.7.1	Questioned and known glasses of the same relative size are placed in a glass container (typically a jacketed or graduated cylinder). Bromoform and methanol are added, and the mixture is adjusted to determine if the particles will suspend together in the liquid. After addition of one of the liquids to adjust density, mix well and allow the mixture to settle. If the particles sink or float, add the appropriate liquid and mix again. Repeat until at least one of the particles suspends in the liquid.	
9.3.4.7.2	If the questioned and known samples suspend together, the glasses are consistent in density.	
9.3.4.7.3	Recover the glass particles from the liquid using filter paper. Retain the liquid mixture for re-use.	
9.3.5	References	
9.3.5.1	Miller, E.T. "Forensic Glass Comparisons", in <u>Forensic Science Handbook</u> ; R. Saferstein, ed, Prentice Hall:Englewood Cliffs, NJ 1982.	
9.3.5.2	Nelson, D.F. "The Examination of Glass Fragments" in <u>Methods of Forensic Science</u> ; A.S. Curry, ed, Interscience Publishers:London.	

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<p>9.4 Refractive Index Measurement by GRIM2 System</p> <p>9.4.1 Purpose</p> <p>This procedure is used to determine the refractive index of a glass sample or individual glass fragment for comparison with other samples or fragments.</p> <p>9.4.2 Minimum Standards and Controls</p> <p>9.4.2.1 Steel pulverizer and work area must be cleaned before and after each use.</p> <p>9.4.2.2 Annual calibration, a monthly QC check and case QC requirements are described in Appendix 10.</p> <p>9.4.2.3 Questioned glass particles recovered from debris from clothing or objects should be cleaned prior to mount preparation to obtain the most suitable data.</p> <p>9.4.3 Analytical Procedures</p> <p>9.4.3.1 Start the GRIM2 system and allow it to stabilize for one hour prior to taking measurements.</p> <p>9.4.3.2 The known glass sample is prepared for refractive index determination. If possible, a fragment is chosen to represent the entire cross section of the glass source. (That is, it should exhibit both manufactured surfaces). The fragment is placed in a pulverizer and crushed.</p> <p>9.4.3.2.1 A small spatula is used to scoop out a sample of fine, crushed glass particles. The particles are placed on the end of a hot stage slide. A drop of the appropriate immersion oil is placed on the crushed sample. Locke Silicone Oil B is used for most window and container glasses. Locke Silicone Oil C is used with headlight glasses. Locke Silicone Oil A is used for samples with high refractive index that are above the refractive index range of the Locke Silicone Oil B. A cover slip is placed over the oil. The slide is marked for identification purposes.</p> <p>9.4.3.3 Prepare the GRIM2 for refractive index measurement by opening the "Glass for Windows" icon on the computer operating system. Create and open a data file for the case. Select the oil and wavelength being used in the measurement.</p> <p>9.4.3.4 The prepared mount is inserted into the hot stage on the phase contrast microscope. The bulk of the particles are located and the microscope is focused on the glass particles.</p> <p>9.4.3.4.1 Using the phase telescope in place of one of the microscope oculars, phase contrast is adjusted by viewing and aligning the phase rings. This is accomplished by pushing in and turning the adjustment knobs for the phase annulus, which is located on the microscope's condenser assembly. The phase should be checked and adjusted for each prepared mount.</p> <p>9.4.3.5 For crushed mounts of known glass samples, perform measurements on a minimum of five (5) fragments for each. Select fragments which exhibit edges with the highest degree of contrast. For samples that exhibit a wide within-sample variation such as tempered glass or other non-annealed glass sources, it is necessary to perform measurements on ten (10) or more fragments to determine the sample's refractive index range.</p> <p>9.4.3.6 Using the appropriate oil, mounts are prepared for questioned glass samples or individual recovered particles.</p>	

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9.4.3.6.1	For large questioned glass fragments, prepare mounts and perform measurements as described in steps 2, 3 and 4 above.	
9.4.3.6.2	For small individual questioned particles, perform a measurement on each particle, selecting an edge on the particle which exhibits the highest degree of contrast.	
9.4.3.6.3	The quality of the refractive index measurement on the GRIM2 system can be assessed by the "Edge Contrast" value assigned to each measured value. This value is shown in parentheses next to the match temperature measurement. The best value is "99", with the value decreasing as edge contrast quality decreases. Glass particles with an edge contrast value of less than "10", in either the cooling or heating measurement cycles, will not be considered as suitable for comparison purposes. Such glass particles must be saved as "Reject" particles and will not be associated with a comparison sample regardless of the measured value.	
9.4.3.6.4	Multiple individual questioned particles may be mounted together on a single slide. If this is done, rough sketching of the mount may be necessary for reference while collecting data.	
9.4.3.7	Print data for the case, including known samples, questioned samples and/or questioned individual particles and the glass standard measured for the case. Draw conclusions which are supported by the data considering all properties being compared.	
9.4.3.7.1	The GRIM2 system calculates refractive index to the fifth decimal place. Refractive index comparisons will be made by rounding to the fourth decimal place. When a glass sample can be measured by taking multiple measurements on a crushed mounting (such as a known glass sample), the mean refractive index value is used for comparison.	
9.4.3.8	It is generally considered that two glasses are consistent in refractive index if their variance is plus or minus 0.0002 at the N _D line (589 nm). The refractive index measurement for recovered glass particles will be compared to the mean refractive index and to the observed refractive index range for the known glass sample. Recovered glass particles with refractive index values that are within 0.0002 at the N _D line of the known glass sample or within the observed refractive index range for the known glass sample are considered to be consistent in refractive index.	
9.4.3.9	Following the examination, individual questioned glass particles are recovered and retained with the evidence.	
9.4.4	References	
9.4.4.1	GRIM2 "Installation and Instruction Manual", November 1997.	
9.4.4.2	Locke Scientific "Reference Glasses and Silicone Oils for Refractive Index Determination".	
9.4.4.3	Locke, J.; Underhill, M. "Automatic Refractive Index Measurement of Glass Particles"; <u>Forensic Science International</u> , 1985, 27, pp. 247-250.	
9.4.4.4	Satterthwaite, M.J.; Harrison, P.H.; Lambert, J.A.; "Glass Refractive Index - Recent Developments in Measurement and Data Handling in UK Forensic Science Service Laboratories".	

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<p>9.5 Mineral Wool Examination</p> <p>9.5.1 Purpose</p> <p>This procedure is used to compare physical properties and refractive index of known and questioned mineral wool samples. Mineral wool is a general term that includes glass wool, slag wool and rock wool.</p> <p>9.5.2 Safety Considerations</p> <p>9.5.2.1 Tongs and insulated gloves should be used when working with a muffle furnace at elevated temperatures.</p> <p>9.5.3 Minimum Standards and Control</p> <p>9.5.3.1 Annealing of known and questioned samples must be performed simultaneously to insure the samples are subjected to identical conditions.</p> <p>9.5.4 Analytical Procedures</p> <p>9.5.4.1 Examine clothing items or objects and recover any foreign mineral wool fibers using applicable procedures described in ¶ 9.2 for recovery of glass particles. Forceps may be used to recover any mineral wool fibers found during visual inspection.</p> <p>9.5.4.2 Compare physical properties of known and questioned samples. Note color of resin, UV fluorescence, presence of slugs and any other physical characteristics that are observed.</p> <p>9.5.4.2.1 Using a polarized light microscope with calibrated reticle, measure the diameter of the fibers in the samples. Also examine using crossed polars to determine if the fibers are isotropic, and therefore identified as glass fibers.</p> <p>9.5.4.3 Place a portion of the known and questioned samples in separate porcelain crucibles and place the samples in a muffle furnace. Initiate an annealing program such as shown below. It may be necessary to adjust the program temperatures and ramp rates based on softening temperature of the samples or the capabilities of the muffle furnace. Record the program parameters used in the case file.</p> <p align="center">Hold 40 C, 1 min Ramp 20 C/min to 550 C Hold 550 C, 30 min Ramp 1 C/min to 450 C Hold 450 C, 1 min Ramp 2 C/min to 40 C End</p> <p>9.5.4.4 If samples are of sufficient size, compare solubility of a portion of the annealed fibers using concentrated HCl. Glass wool - insoluble, Rock wool - soluble, Slag wool - sometimes partially soluble</p> <p>9.5.4.4.1 If no resin is present on the non-annealed sample, this step may be done prior to the annealing procedure.</p> <p>9.5.4.5 Compare the refractive index of the known and questioned annealed samples using applicable procedures described in ¶ 9.4.</p> <p>9.5.4.6 If samples are of sufficient size and non-annealed portions of the samples are still available for further testing, analyze the resin coating chemically using pyrolysis GC.</p>	

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9.5.5	References	
9.5.5.1	Miller, E.T. "Forensic Glass Comparisons", in <u>Forensic Science Handbook</u> ; R. Saferstein, ed, Prentice Hall:Englewood Cliffs, NJ 1982.	
9.6	Direction-of-Impact	
9.6.1	Purpose	
	This procedure is used to determine from which side a window pane was broken.	
9.6.2	Minimum Standards and Controls	
9.6.2.1	A sufficient amount of the total glass fragments from the broken pane must be submitted in order to reconstruct the pane and subsequently make an appropriate conclusion with regard to direction-of-impact.	
9.6.2.2	The submitted glass fragments taken directly from the window frame must be properly labeled as to inside or outside orientation.	
9.6.2.3	The broken glass source must be non-tempered. This determination cannot be made on a tempered glass source.	
9.6.3	Analytical Procedures	
9.6.3.1	Lay out broken pane fragments on paper.	
9.6.3.2	Lay fragments in a consistent surface orientation based on float side fluorescence, paint or surface debris if possible.	
9.6.3.3	Reconstruct the pane as completely as possible.	
9.6.3.4	Determine point(s)-of-impact and attempt to identify radial cracks.	
9.6.3.5	If radial cracks can be identified, examine ridges on these cracks. These ridges are perpendicular to the surface opposite the side-of-impact. 4-R Rule: " <u>R</u> idges on <u>R</u> adial cracks are at <u>R</u> ight angles to the <u>R</u> ear."	
9.6.3.6	Using the correct inside or outside orientation for the broken pane provided by the investigator, determine the direction-of-impact.	
9.6.4	References	
9.6.4.1	Miller, E.T. "Forensic Glass Comparisons", in <u>Forensic Science Handbook</u> ; R. Saferstein, ed, Prentice Hall:Englewood Cliffs, NJ 1982.	
9.6.4.2	Nelson, D.F. "The Examination of Glass Fragments" in <u>Methods of Forensic Science</u> ; A.S. Curry, ed, Interscience Publishers:London.	
9.7	Sequence of Impact	
9.7.1	Purpose	
	This procedure is used to determine the sequence in which multiple impacts have occurred in a broken glass pane.	

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9.7.2	Minimum Standards and Controls	
9.7.2.1	This determination can only be made on non-tempered glass sources. The pane must also hold together long enough for the pattern to develop. Typically, only laminated or wire reinforced panes will do so.	
9.7.3	Analytical Procedures	
9.7.3.1	Determine points-of-impact and identify radial cracks.	
9.7.3.2	If multiple points-of-impact can be identified, examine the cracks formed by each impact and attempt to determine the relationship between these impacts. Cracks formed by a later impact will terminate at cracks already formed by an earlier impact.	
9.7.3.3	Using these observations, determine the sequence of these impacts.	
9.7.4	References	
9.7.4.1	Miller, E.T. "Forensic Glass Comparisons", in <u>Forensic Science Handbook</u> ; R. Saferstein, ed, Prentice Hall:Englewood Cliffs, NJ 1982.	
9.7.4.2	Nelson, D.F. "The Examination of Glass Fragments" in <u>Methods of Forensic Science</u> ; A.S. Curry, ed, Interscience Publishers:London.	
9.8 Documentation		
9.8.1	For glass comparison or identification examinations, all physical properties determined for each item will be listed on a glass worksheet (Appendix 19).	
9.8.2	If refractive index values are determined by the GRIM2 system, a printed copy of the GRIM2 data and a “GRIM2 Instrumentation” worksheet (Appendix 19), which lists the equipment and calibration oils used, will be included in each case file.	
9.8.3	For fracture match, direction-of-impact or sequence-of-impact examinations, photographs and/or sketches will be included.	
9.9 Formation of the Opinion in Glass Comparisons		
<p>The results of a glass comparison are generally reported using statements selected from the report wording guidelines in ¶ 9.10. The strength of an associative conclusion between glass samples is determined by factors such as the number of consistent particles found, the number of broken glass sources transferred and the uniqueness of the properties of the glass. The uniqueness of the refractive index of a glass sample is determined by evaluation of the frequency of occurrence of refractive indices from known glass samples encountered in casework. Frequency of occurrence data will only be considered for flat glass sources, since the current collection of refractive index data does not contain a sufficient sampling of other glass types such as headlight or container glass sources.</p>		
9.10 Report Wording		
<p>To the maximum extent possible, report wording will be selected from the following statements.</p>		
9.10.1	For multiple known samples, use the appropriate statement:	
9.10.1.1	The Items_____ and _____ glass samples could be distinguished from each other based upon differences in physical properties and/or refractive index.	

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9.10.1.2	The Items_____ and _____ glass samples could not be distinguished from each other by physical properties and/or refractive index.	
9.10.1.3	Item_____ is a laminated glass composed of two panes which could be distinguished from each other based upon differences in physical properties and/or refractive index.	
9.10.1.4	Item_____ is a laminated glass composed of two panes which could not be distinguished from each other by physical properties and/or refractive index.	
9.10.2	For associations of glass samples or fragments, use this statement: The Item_____ glass sample/fragments/particle was/were consistent with the Item_____ glass in physical properties and/or refractive index.	
9.10.3	For association of 80% or greater of recovered glass particles (of those examined) from clothing or objects, use this statement: Glass particles were recovered from the combined debris from Items_____ that were consistent with the Item_____ glass in physical properties and/or refractive index.	
9.10.4	For association of less than 80% of recovered glass particles (of those examined) from clothing or objects, use this statement: <u>(#particles)</u> of <u>(total #particles)</u> glass particles recovered from the combined debris from Items_____ were consistent with the Item_____ glass in physical properties and/or refractive index.	
9.10.5	Include this statement if needed: Physical properties could not be determined due to particle size	
9.10.6	For association of glasses, use the appropriate opinion statement, based on the uniqueness of the glass source or sources:	
9.10.6.1	Environmental origin could not be eliminated as a possible source of these particles.	
9.10.6.2	It was concluded that these particles could have originated from the broken glass source represented by Item_____.	
9.10.6.3	It is considered unlikely/extremely remote that these particles originated from any source other than the broken glass source represented by Item_____.	
9.10.7	For non-associations, use the appropriate statement:	
9.10.7.1	The Item_____ glass sample/fragments/particle could not be associated with the Item_____ glass due to differences in physical properties and/or refractive index.	
9.10.7.2	Glass particles recovered from the combined debris from Items_____ could not be associated with the Item_____ glass due to differences in physical properties and/or refractive index.	
9.10.8	If no glass particles are recovered, use this statement: No glass particles were recovered from the combined debris from Items_____ for comparison to the Item_____ glass.	
9.10.9	For recovered glass where knowns are being requested for comparison purposes the report will generally read:	

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<p>Glass particles were recovered from Item __. If a known source of glass is located, resubmit Item __ along with the known glass for comparison.</p> <p align="right">◆End</p>	